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FLUORIDE IN VEGETATION NEAR A PHOSPHOROUS MANUFACTURING PLANT IN THE VICINITY OF BUTTE, MONTANA

by

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A phosphorous manufacturing plant owned by Stauffer Chemical Company is located about 6 miles west of Butte, Montana. During the high-temperature reduction of mineral calcium phosphate, fluorides, primarily in dust form, are released to the atmosphere. These fluorides, occurring naturally in small quantities in the phosphate ore, are then deposited in the general area proximal to the production facility.

Excessive amounts of fluorides are detrimental to plant and animal health.[1/] Vegetation can be killed or severely injured near fluoride-emitting sources. Because plants tend to accumulate fluorides, animals foraging near fluoride-emitting sources may ingest large quantities of fluorides. Cattle, deer, and other animals near aluminum plants and phosphate fertilizer plants often have skeletal fluorosis and partially disintegrated teeth. In advanced stages, the health of the animal may be very poor.

Because fluorides emitted from the phosphorous plant represent a threat to vegetation and animals on public lands nearby, it was decided a survey should be made to evaluate the potential problem. Specifically, the objectives were:

1. Determine the amount of fluoride in tissue of plant species growing on several parcels of public land around the facility.

2. Assess fluoride-caused injury to vegetation around the phosphate facility.

1/ Fluorides. National Academy of Sciences, Washington, D.C., 295 pp., 1971.

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EXPERIMENT STATION

METHODS

Seven collection sites were selected, generally downwind of the phosphorous plant (Fig. 1). All but No. 2 were on U.S. Forest Service lands. The following types of vegetation, if available, were collected at each site:

1. Conifer, current and 1-year-old needles.
2. Shrub, current foliage.
3. Grass, current foliage.

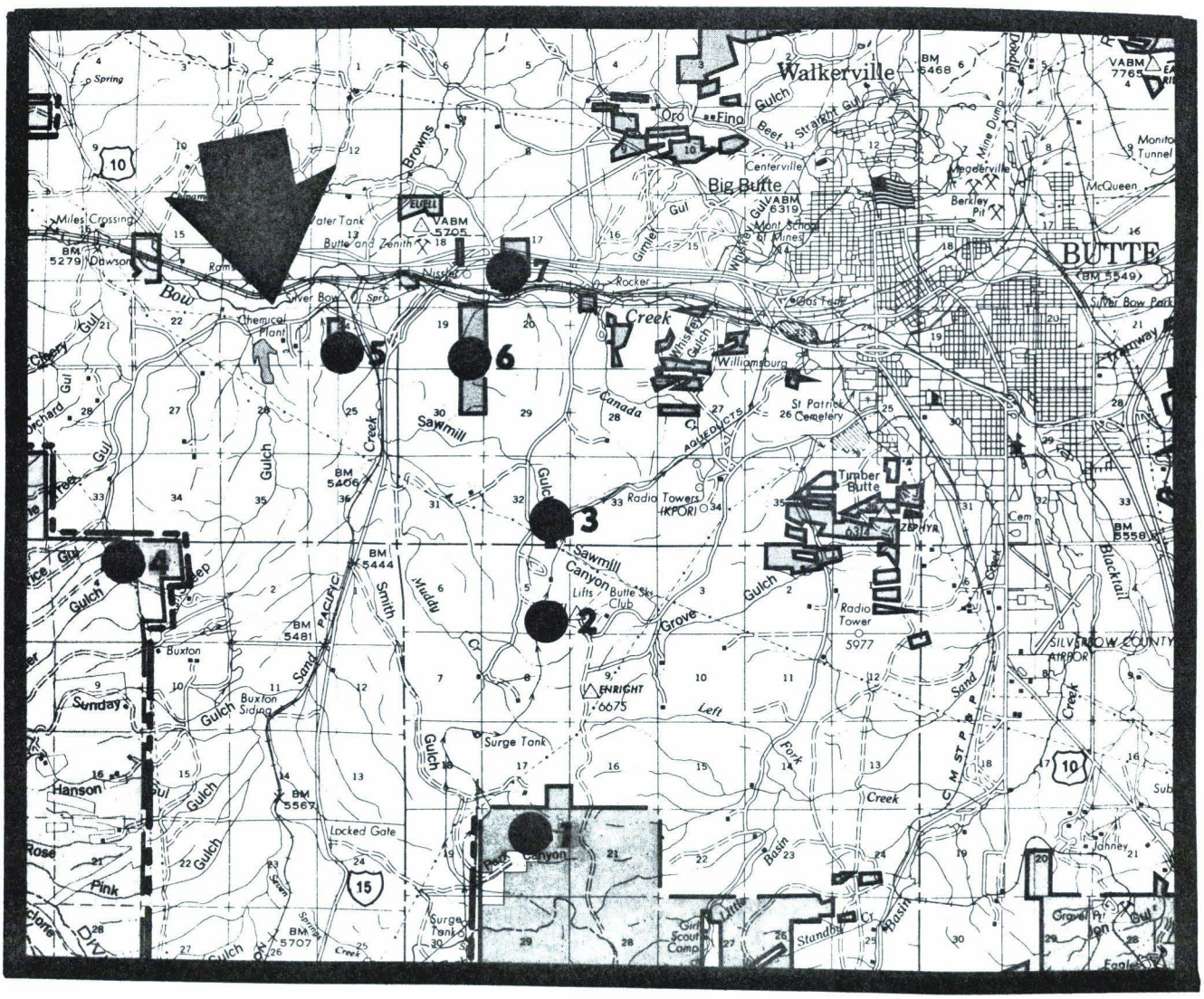

Figure 1.--Location of Stauffer Chemical Company and vegetation collection areas. Large black arrow indicates location of Stauffer Chemical Company. Plot locations where vegetation was collected are numbered and represented by solid circles. All plots except No. 2 are on U.S. Forest Service land.

All samples were then brought to the U.S. Forest Service regional laboratory in Missoula, Montana, and analyzed for available fluorides.[2/] A specific ion probe was used to determine fluoride content. Results were given in p.p.m. (parts per million) based on the dry weight of the tissue. Control samples were not collected in this area because of the long history of air pollution in the Deer Lodge Valley. Instead, results were compared to control data collected during a fluoride study at Columbia Falls, Montana.[3/]

Coniferous foliage was observed for symptoms of fluoride injury, including necrotic needle tips, below-average needle length, and premature needle casting.

Field collections were made in late May 1972. Laboratory work was done in October 1972.

RESULTS AND DISCUSSION

Fluoride content of each sample collected is given in table 1.

Amounts range from 9.4 p.p.m. in 1972 Douglas-fir foliage at site No. 3 to 74.2 p.p.m. in 1971 crested wheatgrass foliage at site No. 5. All except two analyses showed more than 10 p.p.m. fluoride, the control level established at Columbia Falls. Generally, vegetation in plots close to the chemical factory had higher fluoride than those distant, supporting the assumption that Stauffer is the source of the excessive fluorides.

The Montana State Standard for maximum allowable fluoride in forage is 35 p.p.m. This value was exceeded at sites 3 and 5, and site 7 if one considers Douglas-fir as forage.

We did not find any visible symptoms of fluoride-caused injury on coniferous foliage.

A separate study was done by Mr. Charles Van Hook, University of Montana, late in 1972. Although his data is not yet published, it was more extensive than ours, and at this time supports the data we collected.

2/ Available fluorides include inorganic fluoride within and on the needle tissue.

3/ Carlson, Clinton E., and Jerald E. Dewey. Environmental pollution by fluorides in Flathead National Forest and Glacier National Park. USDA, Forest Service, Region 1, Missoula, Montana 59801, 57 pp., 1971.

Table 1.--Fluoride content of vegetation samples collected near Stauffer Chemical Company, Butte, Montana

Location	Species	Year of foliage	Fluoride p.p.m.
1	Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco)	1970	20.8
		1971	21.0
	Lodgepole pine (*Pinus contorta* var. *latifolia* Engelm.)	1971	15.8
		1972	12.8
	Juniper (*Juniperus occidentalis* Hook)	Composite 1970, 71, 72	17.6
2	Douglas-fir	1971	34.8
		1972	9.8
3	Douglas-fir	1971	23.6
		1972	9.4
	Bluebunch wheatgrass (*Agropyron spicatum* (Pursh) (Scribn. & Smith))	1971	40.8
4	Douglas-fir	1971	28.6
		1972	16.2
	Bluebunch wheatgrass	1971	21.2
5	Rabbitbrush (*Chrysothamus* sp.)	1971	53.8
		1972	28.6
	Crested wheatgrass (*Agropyron cristatum* (L.) Gaertn.)	1971	74.2
6	Rabbitbrush	Composite 1971, 72	28.9
	Bluebunch wheatgrass	1971	16.4
7	Douglas-fir	1971	39.2
		1972	21.2
	Bluebunch wheatgrass	1971	16.4

CONCLUSIONS

The following conclusions can be made in relation to this survey:

1. Vegetation within a 6-mile radius south and east of Stauffer Chemical Company's phosphorous plant near Butte, Montana, is accumulating excessive amounts of fluoride.

2. It is highly probable the fluorides originate at the phosphorous plant.

3. Close to the facility--within 1 mile--forage has accumulated more fluoride than the State standard allows. These high amounts of fluoride may be injurious to animals feeding on contaminated vegetation.